Kentucky
Epidemiologic Notes & Reports

CABINET FOR HEALTH SERVICES
DEPARTMENT FOR PUBLIC HEALTH
DIVISION OF EPIDEMIOLOGY

Volume 32 Number 10 October 1997

Staphylococcus aureus with Reduced Susceptibility to Vancomycin — United States, 1997

SOURCE: MMWR 46(33);765-766 DATE: Aug. 22, 1997

Staphylococcus aureus is one of the most common causes of both hospital- and community-acquired infections worldwide, and the antimicrobial agent vancomycin has been used to treat many *S. aureus* infections, particularly those caused by methicillin-resistant *S. aureus* (MRSA). In 1996, the first documented case of infection caused by a strain of *S. aureus* with intermediate levels of resistance to vancomycin (VISA; minimum inhibitory concentration {MIC}=8 µg/mL) was reported from Japan.[1] This report describes the first isolation of VISA from a patient in the United States, which may be an early warning that *S. aureus* strains with full resistance to vancomycin will emerge.

In July 1997, VISA-associated peritonitis was diagnosed in a patient who was being treated with long-term ambulatory peritoneal dialysis. During January 1996-June 1997, the patient had been treated with multiple courses of both intraperitoneal and intravenous vancomycin for repeated episodes of MRSA-associated peritonitis. The patient received medical care primarily at home; when hospitalized, the patient had been placed on contact isolation precautions because of known MRSA.

Six isolates of *S. aureus* obtained from one specimen from this patient in July were sent to CDC for species confirmation and antimicrobial susceptibility testing. The identity of these isolates was confirmed, and of the six, one demonstrated a vanco-mycin MIC of 8 µg/mL (National Committee for Clinical Laboratory Standards breakpoints for susceptibility: susceptible, less than or equal to ≤4 µ g/mL; intermediate, 8-16 µg/mL; and resistant, greater than or equal to ≥32 µg/mL).[2] The VISA isolate was susceptible to rifampin, chloramphenicol, trimethoprim-sulfamethoxazole, and tetracycline. The patient is continuing to receive ntimicrobial therapy. Epidemiologic and laboratory investigations are under way to assess the risk for person-to-person transmission of VISA and to determine the mechanism(s) by which these strains develop resistance.

Editorial Note: Since the 1980s, when MRSA emerged in the United States, vancomycin has been the last uniformly effective antimicrobial available for treatment of serious *S. aureus* infections. This report documents the emergence of VISA in the United States and may signal the eventual emergence of *S. aureus* strains with full resistance to vancomycin. Widespread use of antimicrobials, such as vancomycin, is a major contributing factor for the emergence of vancomycin-resistant organisms, including vancomycin-resistant enterococci.

To accurately detect staphylococci with reduced susceptibility to vancomycin, antimicrobial susceptibility should be determined with a quantitative method (broth dilution, agar dilution, or agar gradient diffusion) using a full 24 hours of incubation at 95 F (35 C). Strains of staphylococci with vancomycin MICs of 8 µg/mL were not detected using disk-diffusion procedures.

To prevent the spread of these organisms within and between facilities, health-care providers and facilities are advised to 1) ensure the appropriate use of vancomycin[3]; 2) educate those personnel who provide direct patient care about the epidemiologic implications of such strains and the infection-control precautions necessary for containment; 3) strictly adhere to and monitor compliance with contact isolation precautions and other recommended infection-control practices, and 4) conduct surveillance to monitor the emergence of resistant strains. Detailed recommendations for the prevention, detection, and control of *S. aureus* strainswith reduced susceptibility to vancomycin are outlined in "Interim Guidelines for Prevention and Control of Staphylococcal Infection Associated with Reduced Susceptibility to Vancomycin," published previously in MMWR.[4]

In this issue . . . .

Emerging Foodborne Diseases

Adapted from Emerging Infectious Diseases, Vol. 3, No. 3, July-September, 1997

By: S.F. Altekruse, M.L. Cohen, and D.L. Swerdlow
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Foodborne diseases have a major public health impact.[1] In the United States, each year foodborne illnesses affect 6 to 80 million persons, cause 9,000 deaths, and cost an estimated 5 billion U.S. dollars.[2] The epidemiology of foodborne diseases is rapidly changing as newly recognized pathogens emerge and well-recognized pathogens increase in prevalence or become associated with new food vehicles (Table 1). In addition to acute gastroenteritis, many emerging foodborne diseases may cause chronic sequelae or disability. Listeriosis, for example, can cause miscarriages[2] or result in meningitis in patients with chronic diseases.[3] Toxoplasmosis is an important cause of congenital malformation,[4] and *Escherichia coli* O157:H7 infection is a leading cause of hemolytic uremic syndrome, the most common cause of acute kidney failure in children in the United States.[5] Salmonellosis can cause invasive disease[6] or reactive arthritis,[7] and campylobacteriosis can lead to Guillain-Barre syndrome, one of the most common causes of flaccid paralysis in the United States in the last 50 years.[8]

Table 1. Selected outbreaks in the United States 1988-1997, associated with emerging foodborne pathogens and factors for the emergence of these pathogens

Pathogens/outbreak	Location(s)	Year	Factors in emergence
Hepatitis A Frozen strawberries	MI	1997	international travel and commerce technology and industry
Salmonella Typhimurium DT104 Farm visit	NE	1996	microbial adaptation
Cyclospora cayetanensis Guatemalan raspberries	Multistate, Canada	1996	international travel and commerce
Salmonella Enteritidis PT4 Egg-containing foods	CA	1995	international travel and commerce technology and industry
Salmonella Enteritidis Mass-distributed ice cream	Multistate	1994	technology and industry
Norwalk-like virus Gulf Cost oysters	LA	1994	economic development and land use
Escherichia coli O157:H7 Fast-food chain hamburgers	Multistate	1993	technology and industry; breakdown of public health measures
Escherichia coli O157:H7 Raw apple cider	MA	1991	human demographics and behavior technology and industry

SELECTED FOODBORNE PATHOGENS OF PUBLIC HEALTH IMPORTANCE

Salmonella Serotype Enteritidis

Nontyphoidal salmonellosis is one of the most commonly reported infections in the United States. The doubling of salmonellosis incidence in the last two decades has accompanied modern food industries' centralized production and large-scale distribution. The most prevalent serotypes, *Salmonella* serotype Enteritidis (SE), *Salmonella* Typhimurium, and *Salmonella* Heidelberg, account for most human salmonellosis in the United States.

SE's ability to cause ovarian infections in egg-laying hens,thus contaminating the contents of intact shell eggs, has been important in the transmission of SE among humans and hens.[11] SE can be transmitted vertically from breeding flocks to egg-laying hens, which in turn produce contaminated eggs.[10,11] Once the organism is present in a flock, the infection is difficult to eliminate because transmission is sustained by environmental sources including rodents and manure.

Campylobacter jejuni

Campylobacter jejuni, an emerging foodborne pathogen not recognized as a cause of human illness until the late 1970s, is now considered the leading cause of foodborne bacterial infection.[12] An estimated four million *C. jejuni* infections occur each year in the United States; most sporadic infections are associated with improper preparation or consumption of mishandled poultry products.[12] Incidence of campylobacteriosis is particularly high among young men which may reflect poor food preparation skills in this group.[12] Most *C. jejuni* outbreaks, which are far less common than sporadic illnesses, are associated with consumption of raw milk or unchlorinated water.[12]

E. coli O157:H7

E. coli O157:H7 was first recognized as a human pathogen in 1982 when two outbreaks in the United States were associated with consumption of undercooked hamburgers from a fast-food restaurant chain.[13] The pathogen has since emerged as a major cause of bloody and nonbloody diarrhea, causing as many as 20,000 cases and 250 deaths per year in the United States.[2,5] Consumption of ground beef,[13] lettuce,[14] raw cider,[15] raw milk, and untreated water have been implicated in outbreaks, and person-to-person transmission is well documented.[5]

FACTORS CONTRIBUTING TO THE EMERGENCE OF FOODBORNE DISEASES

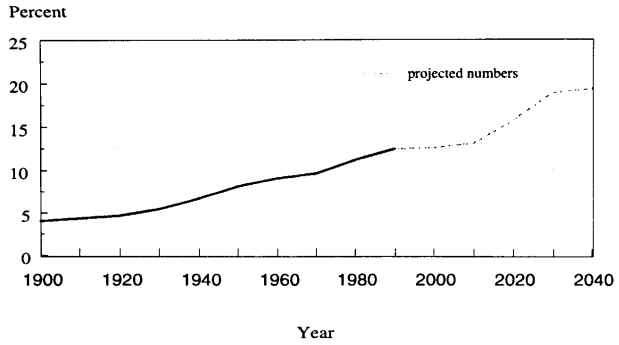
Human Demographics

Because of demographic changes in industrialized nations,

the proportion of the population with heightened susceptibility to severe foodborne infections has increased. In the United States, a growing segment of the population is immunocompromised as a consequence of infection with human immunodeficiency virus (HIV) or underlying chronic disease. Reported rates of salmonellosis, campylobacteriosis, and listeriosis were higher among HIV-infected persons than among those not infected with HIV.[6]

During the 20th century, the median age of the U.S. population steadily increased,[18] a trend that is accelerating. (Figure 1). The elderly are at increased susceptibility to foodborne infections.

Figure 1. Percentage of U.S. population over 65 years of age, 1990-2040 (projected). Source: U.S. Bureau of Census



Advances in medical technology (e.g., organ transplantation and cancer therapy) have extended the life expectancy of persons with chronic diseases, thus increasing the proportion of the population with heightened susceptibility to severe foodborne illness.[20]

Human Behavior

Changes in food consumption have brought to light unrecognized microbial foodborne hazards. Fresh fruit and vegetable consumption, for example, has increased nearly 50% from 1970 to 1994.[21] Fresh produce is susceptible to contamination during growth, harvest, and distribution. The surface of plants and fruits may be contaminated by human or animal feces. Pathogens on the surface of produce (e.g., melons) can contaminate the inner surface during cutting and multiply if the fruit is held at room temperature.[22] In the United States from 1990 to 1997, increased consumption of fresh produce may have contributed to a series of foodborne outbreaks associated with foods such as sliced cantaloupe,[22] green onions,[23] alfalfa sprouts,[26] and sliced tomatoes.[27]

Fast-food restaurants and salad bars were rare 50 years ago but are primary sites for food consumption in today's fast-paced society.[29] Outbreaks outside the home account for almost 80% of reported outbreaks in the United States in the 1990s.[30]

Behavioral changes leading to foodborne infections are further complicated by decreased opportunities for food safety instruction both in school and at home. In addition, because of two-income families and increased eating away from home, fewer opportunities may exist to pass food safety information from parent to child.[29]

Changes in Industry and Technology

The trend toward greater geographic distribution of products from large centralized food processors carries a risk for dispersed outbreaks. [32]

In 1985, an outbreak of salmonellosis associated with contaminated milk from a large midwestern dairy was estimated to have resulted in approximately 250,000 illnesses. A nationwide outbreak of *Salmonella* serotype Enteritidis of similar magnitude occurred in 1994 when ice cream premix was transported in tanker trucks that had not been thoroughly sanitized after transporting raw liquid egg. [34] Changes in egg production have adversely affected infection control in poultry flocks. [35] In 1945, a typical hen house contained 500 birds. By 1995, many houses contained 100,000 hens, and multiple houses were often linked by common machinery, [35] resulting in large flocks with common risk profiles. Large-scale distribution of shell eggs from infected flocks has caused outbreaks in which contaminated eggs were distributed in many states over a period of months.[10]

Changes in Travel and Commerce

Five million international tourist arrivals were reported worldwide in 1950, and the number is expected to reach 937 million by 2010. Travelers may become infected with foodborne pathogens uncommon in their nation of residence, thus complicating diagnosis and treatment when their symptoms begin after they return home. In 1992, for example, an outbreak of cholera caused 75 illnesses in international airline passengers; 10 persons were hospitalized, and one died.[37] Pathogens may also be carried home to infect nontravelers.[38]

As the diversity of foods in the marketplace has increased, illnesses have been associated with internationally distributed foods. In 1996, 1,465 cases of infection with *Cyclospora cayetanensis* were reported by 20 states, the District of Columbia, and two Canadian provinces. The investigation implicated raspberries from Guatemala.[25]

In the mid-1990s, half to one and one-half million immigrants were admitted to the United States each year. Outbreaks of trichinosis have become relatively rare in the United States because cooking pork thoroughly has become a widespread cultural practice. An exception occurred in 1990, when Laotian immigrants in Iowa prepared and ate undercooked pork, a traditional food, in celebration of a wedding.[40] Other reports involve foods consumed by ethnic populations. *Yersinia enterocolitica* outbreaks are also rare, but several have occurred in inner-city African-American

communities and were associated with preparation and consumption of pork intestines.[41]

MICROBIAL ADAPTATION

Environmental Conditions

Natural selection is a key process in the emergence of pathogens. Microbes adapt to have an advantage in unfavorable environments (e.g., heat and acidity). SE phage type (PT) 4 may have developed traits that enable it to rapidly replace closely related SE phage types in egg-laying poultry environments.[43] During the 1980s, for example, SE PT 4 became the predominant phage type in humans and poultry in Europe and caused a marked increase in human illnesses.

Antimicrobial Resistance

The therapeutic use of an antimicrobial agent, in human or animal populations, creates a selective pressure that favors survival of bacterial strains resistant to the agent. In the United States,the percentage of antimicrobial resistant *Salmonella* infections increased from 17% of isolates in the late 1970s to 31% in the late 1980s.[45] Compared with patients with susceptible infections, patients with antimicrobial-resistant infections are more likely to require hospitalization and to be hospitalized for longer periods.[45]

Salmonella serotype Typhimurium Definitive Type 104 (DT 104) is rapidly emerging in the United States. A study of *S.* Typhimurium isolates from the Pacific Northwest indicated that 43% of human isolates obtained in 1994 had DT 104 isolates resistant to ampicillin, choloramphenicol, streptomycin, sulphonamides and tetracycline (R-type ACSSuT) compared with 4% in 1989.

Economic Development and Land Use

In the United States, food animals generate over 1.6 billion tons of manure per year. [50] On large-scale production facilities, manure disposal is a growing problem. Without disposal, manure may serve as a reservoir for *Salmonella, C. jejuni,* and other farm pathogens.

The shift from a cold season oyster harvest in the Gulf of Mexico to a year-round harvest [57] is a change in resource use associated with the emergence of *V. vulnificus*. Although the annual oyster harvest from the U.S. Gulf of Mexico has not changed since the 1930s, the percentage of oysters harvested during summer months increased from 8% of the annual harvest in 1970 to 30% in 1994. The disposal of feces in oyster beds by oyster harvesters with gastroenteritis has been implicated in shellfish-associated Norwalk-like virus outbreaks, including one in Louisiana in 1994.[53]

Breakdown of the Public Health Infrastructure

Many public health agencies operate with extremely limited resources. The consequent breakdown in public health infrastructure increases the potential for underreporting of foodborne infections.[54] In the mid-1990s, for example, 12 states had no personnel dedicated to foodborne disease surveillance, [54] largely because of budget restrictions at the state and local levels. When the infrastructure for infectious diseases surveillance is compromised, recognition of outbreaks is jeopardized.[9,54]

Prevention and Control

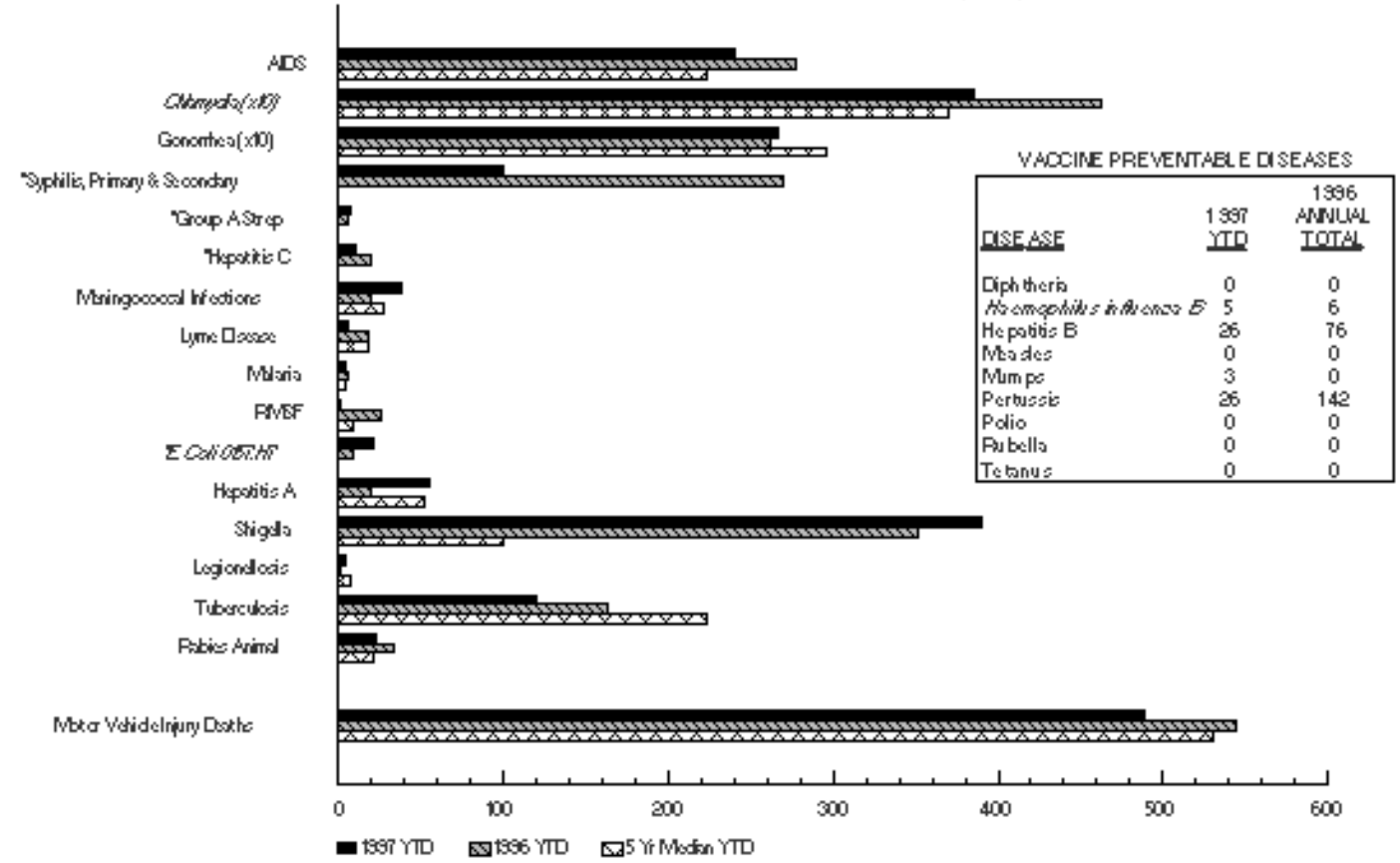
The prevention of foodborne disease depends on careful food production, handling of raw products, and preparation of finished foods. Hazards can be introduced at any point from farm to table. Technologies are available to prevent many foodborne illnesses. Industrial engineering can hold the key to food safety in the 21st century. Among technologies that merit evaluation are chlorination of drinking water sources for food animals; sanitary slaughter and processing of meat,[56] poultry,[56] and seafood;[57] irradiation; and other microbial reduction steps for raw agricultural commodities.

Preparers of meals are the last critical control point before foods reach the table. Interventions to promote safe food preparation practices are needed.[59] Food preparers can reduce the risk of foodborne diseases with a few practical food-handling precautions. Thorough heating of potentially hazardous foods kills pathogens, and refrigeration prevents their multiplication. Cross-contamination of foods can be avoided by separating cooked and raw foods and preventing contamination of cooked foods by drippings from raw foods. Foodworkers should wash hands, cutting boards,and contaminated surfaces as warranted to prevent cross-contamination. Consumers can reduce the risk of foodborne infections by avoiding high-risk foods, such as runny eggs, hamburgers that are pink at the center, and raw shellfish.

Each link in the production, preparation, and delivery of food can be a hazard to health. While technologies designed to improve the safety of the food supply hold promise, changes in food processing, products, practices,and people will continue to facilitate the emergence of foodborne pathogens into the next century. Foodborne disease surveillance provides a basis for detecting disease and identifying points at which new strategies are needed to protect the food supply.

CANCELLATION. . . . . The Department for Public Health's Immunization Program will not be airing the Hepatitis C: Diagnosis, Clinical Management & Prevention videoconference on Saturday, November 22, 1997. For a downlink site near you please call the Hepatitis Foundation International (HFI) at 1-800-891-0707 or contact a Columbia-owned hospital in your area. A tape of this program will be available through the Videoconference Tape Library — call Sandy Williams at 1-502-564-4990 to borrow it.

CASES OF SELECTED REPORTABLE DISEASES IN KENTUCKY, YEAR TO DATE (YTD) THROUGH AUGUST 1997



VACCINE PREVENTABLE DISEASES

DISEASE	1997 YTD	1996 ANNUAL TOTAL
Diphtheria	0	0
Haemophilus influenzae B	5	6
Hepatitis B	26	76
Measles	0	0
Mumps	3	0
Pertussis	26	142
Polio	0	0
Rubella	0	0
Tetanus	0	0

*Historical data are not available.
Disease number reflect only those cases which meet the surveillance definition.
Contributed by: Patricia Booker, Surveillance & Investigations Branch.

KENTUCKY EPIDEMIOLOGIC NOTES & REPORTS
Printed With State Funds
by the
COMMONWEALTH OF KENTUCKY
CABINET FOR HEALTH SERVICES
DEPARTMENT FOR PUBLIC HEALTH
275 EAST MAIN STREET
FRANKFORT, KENTUCKY 40621

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***Staphylococcus aureus* (continued from page 1)**

(See *Staphylococcus aureus* continued on page 6)

The isolation of *S. aureus* with confirmed or "presumptive" reduced vancomycin susceptibility should be reported through state and local health departments to CDC's Investigation and Prevention Branch, Hospital Infections Program, National Center for Infectious Diseases, Mailstop E69, 1600 Clifton Road, NE, Atlanta, GA 30333; telephone (404) 639-6413. Physicians treating patients with infections caused by staphylococci with reduced susceptibility to vancomycin can obtain information about investigational drug therapies from the Food and Drug Administration's Division of Anti-Infective Drug Products, telephone (301) 827-2120.

Kentucky Editorial Note: There have been no reports to the Department for Public Health, Division of Epidemiology, of *S. aureus* with reduced susceptibility to Vancomycin. We have received a report of Vancomycin-resistant enterococcus (VRE) from a blood culture of a four-month old boy. Additionally, through interstate reciprocal notification of disease, we have received reports of VRE in Kentucky residents who were diagnosed in Ohio (three) and Tennessee (one).

Kentucky Administrative Regulation KAR 2:020, requires all laboratories licensed in Kentucky to report the numbers of isolates and information regarding anti-microbial resistance patterns of the isolates to the Department for Public Health. Specific isolates are *Streptococcus pneumoniae*, *Staphylococcus aureus*; enterococcus species or other organisms of public health importance when requested by the Department. To report outbreaks of resistant organisms, call Karen M. Adams R.N., in the